# Ion Chromatography

*The most common use of ion chromatography (IC) is for quantitative and qualitative determinations of inorganic and organic anions in aqueous solutions at concentrations greater than 10 ppb. Several anions can be determined at once. Analysis of cations, such as ammonium and alkali metal ions, is also possible.*

## Principle of Technique

A sample is injected into a pumped, solution-carrier stream that passes through an ion-exchange column. Ions are separated and sequentially measured by means of a conductivity or amperometric detector.

## Samples

***Form.*** Aqueous solutions are needed.

***Size.*** A minimum of 1 mL of sample is needed with analyte present at greater than 10 ppb.

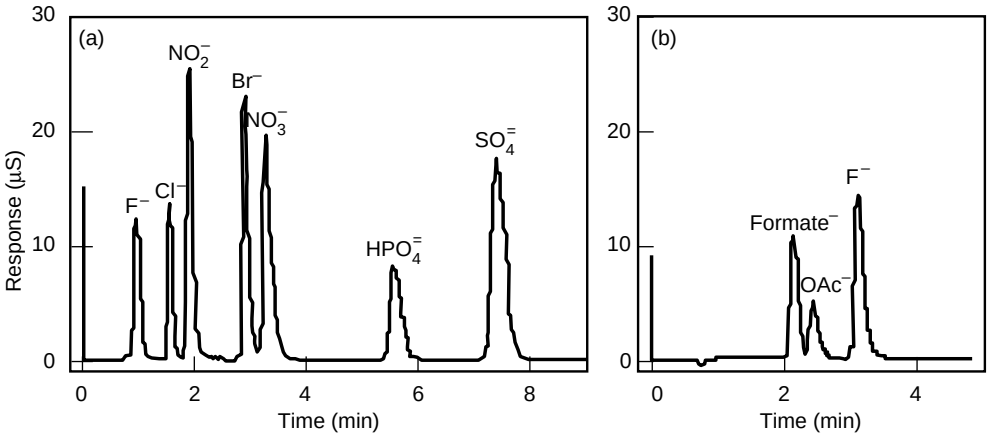
***Preparation.*** Aqueous solutions can usually be analyzed as received or after dilution. A complex solution such as sea water may require prior extraction to remove interfering constituents.

## Limitations

Species must be ionized in solution, preferably anionic. Free, not bound, anions are measured. Separation of analyte from matrix ions is usually required if solution is of high ionic strength (e.g., brines and sea water). Precision is usually about 0.5 to 2% of the concentration measured. Special methods are required for anions of very weak acids such as sulfide and cyanide.

## Estimated Analysis Time

After the concentration has been adjusted to match the range of standards, 15 min to 1 h per sample is needed for analysis of aqueous solutions. Development time may be required for some organic acid anions or if novel separations are needed.




Ion chromatograms of standard anion mixtures used for calibration or as controls for the analysis of unknown mixtures on a 250-mm Dionex AS4A column: (a) principal anions with 1.8 mM $Na_2CO_3$ and 1.7 mM $NaHCO_3$ as eluant; (b) early eluters with 5 mM $Na_2B_2O_7$ as eluant.

## Examples of Applications

- Measurement of fluoride ion in hazardous waste.
- Simultaneous determination of fluoride, chloride, sulfate, sulfite, nitrate, nitrite, and phosphate in ground water.
- Measurement of acetate and propionate in experimental solutions.
- Measurement of anions from combustion of explosives.
- Characterization of high-purity water.
- Analysis of formaldehyde after formation of the bisulfite adduct.
- Determination of anions on contaminated surfaces.

## Capabilities of Related Techniques

Capillary electrophoresis determines the same ions as does IC and some additional ions as well. Capillary electrophoresis is the method of choice for particularly difficult analyses of research samples.

Potentiometric titrations and ion-selective electrode methods are possible for many anions. These may be superior for high ionic strength solutions and for cyanide and sulfide ions.

Aqueous carbonate species are better measured using a total organic carbon analyzer, and silicate is more easily measured as silicon by plasma or atomic absorption spectroscopy.

Work performed under the auspices of the U.S. Department of Energy by Lawrence Livermore National Laboratory under Contract W-7405-Eng-48.